Introduction to PC Operation

After completing the installation procedures described in the previous chapter, your Series One or Series One Plus PC is ready for operation. This chapter describes the operation sequences for those PCs. A description of the features and functions of the programmer are the basis for the information in this chapter. The last portion of this chapter describes the operation of peripheral devices that can be used with the Series One or Series One Plus. The information in this chapter will allow you to become familiar with the programmer keys and the keystroke sequences required for the various programmer operations.

Programmer

The hand-held programmer (figure 4-1), when connected to a PC by one of the three methods described in the previous chapter, can be used for entering a new program, examining a previously entered program, editing (changing) a previously entered program if required, monitoring the status of input or output points, displaying the contents of registers, and displaying timer or counter accumulated values. In addition, with the Series One Plus, a password can be entered with the programmer to protect the contents of your program from unauthorized or inadvertent entry or changing. Its features and functions are described in the following paragraphs. For detailed descriptions of the programming functions, refer to programming, Chapter 5.

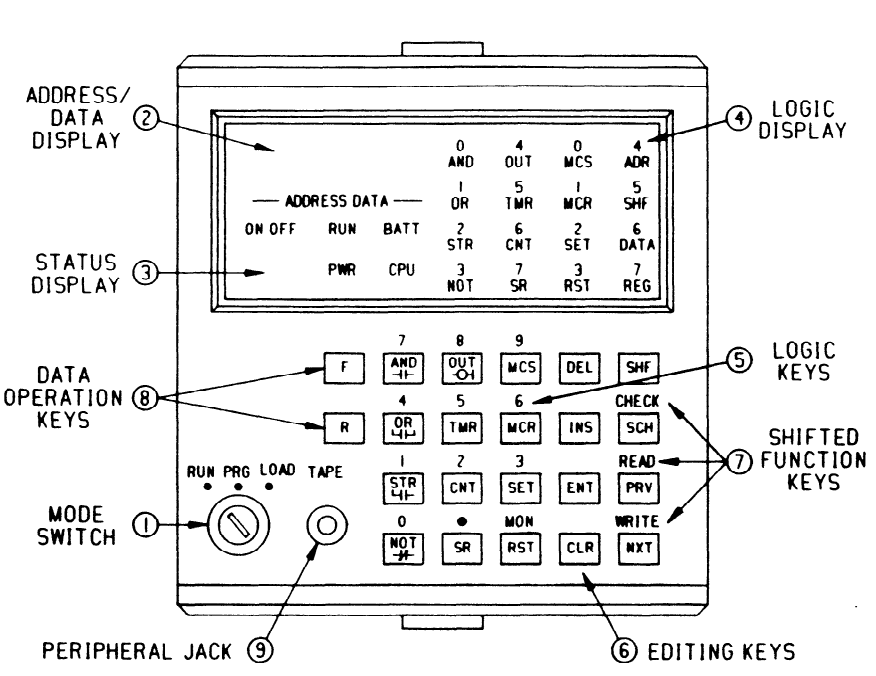


Figure 4-1. Programmer Features

Programmer Features

The programmer features shown in the illustration on the previous page are described in this section. The descriptions of the features are keyed to the numbers (1 to 8) next to each feature in the illustration.

1. **Mode Switch**
   This is a three-position keyswitch used for selecting the operating mode of the PC. This switch can be repositioned at any time as necessary without disrupting AC power. The left position (RUN) allows program execution with outputs enabled. The CPU scans its stored logic and allows timer/counter and relay contacts to be displayed. However, in the Run mode, changes to the logic are not allowed. In the center (PRG or Program) position, new programs can be entered and previously entered logic can be altered; however, no solving of the logic is performed. The right (LOAD) position connects the programmer to an external device such as a tape recorder through the adjacent tape port. Logic is not solved while in the LOAD position.

WARNING

If a version A or B (IC610CPU101A OR IC610CPU101B) CPU IS installed, the Series One programmable controller will always power up in the run (operating) mode unless a programmer is connected and the programmer is in the program or load mode.

2. **Address Data Display**
   This is a four digit display used to indicate either the address, in decimal format, of where the display is in the user program stored in the PC's memory or reference data used as a part of the logic. To indicate that addresses are being displayed, periods appear near the bottom and to the right of each digit (for example, 0.1.2.3.). The LED to the top right behind ADR will also be lit.
3. **Status Display**
   These five LEDs are energized to indicate the following functions or status of the Series One:

ON/OFF When in the Run mode, this LED indicates the status of discrete references (I/O, internal coils, and shift register stages). It is ON when a reference is energized and OFF when de-energized.

RUN ON when in the RUN mode and CPU is solving logic.

BATT ON when the voltage of the internal lithium battery, which is used for maintaining the program stored in CMOS memory during no-power conditions, is at a low level and should be replaced within 10 days - see Chapter 7. This LED is OFF when battery voltage is OK, or battery is disconnected.

PWR ON when the internal power supply is producing DC power. If OFF the rack power supply should be checked - see Chapter 7.

CPU ON when internal error checking has detected a fault in internal hardware - see Chapter 7.

The above four LEDs (RUN, BATT, PWR and CPU) duplicate the operation of the indicators on the CPU when the programmer is installed.

4. **Logic Display**
   These sixteen LEDs are used to indicate the type of logic entered into memory. While being programmed, they reflect the logic selected by the user prior to actual entry into CPU memory. For definition of the first 12 LEDs functions, see key definitions under 5 below. The 4 LED's to the right have special functions as follows:

ADR ON when display is indicating an address value. The address is displayed in decimal notation, beginning at 0000 and ending at the last address in the user program or a maximum of 1723 (maximum number of 16-bit words in memory is 1724).

SHF ON when operator has selected the Shift key and is an indication that future key selections will be based upon the upper key labels. Shift function will remain in effect until either the Enter or Clear key is selected.

DATA (Series One Plus only) On when monitoring the contents of a register and the Address/Data display contains the data (4-digit BCD value) in that register. The contents of 2 consecutive registers will be displayed.

REG (Series One Plus only) On when monitoring the contents of a register and the address of the selected register is displayed. The display can be alternated between REG and DATA by depressing MON.

These sixteen LEDs can also indicate the status of 16 consecutive I/O states when used with the monitor function discussed later in this chapter. The numerals above the alphabetical characters are used during this function.

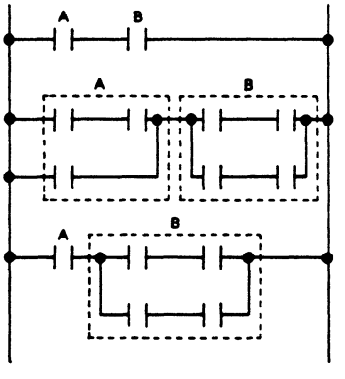
5. **Logic Keys**

These twelve keys are used to select the required function and enter logic when in the Program mode. The upper labels are used to enter numerical values when preceded by the Shift key. Numerical values, when entered, are viewed in the Address Data display. The decimal point is used only for the entry of timer preset values in tenths of a second. The Monitor function will be discussed below as part of the Upper Case keys. The function of the lower or normal case labels on these keys is described in the following key discussion.

AND Places logic such as two contacts or two groups of contacts in series (see figure 4-2). Power flow must be possible through both elements before it will be passed to the next element.

OR Places logic such as two contacts or two groups of contacts in parallel (see figure 4-3). Power flow can be possible through either (or both) elements before it will be passed to the next element.

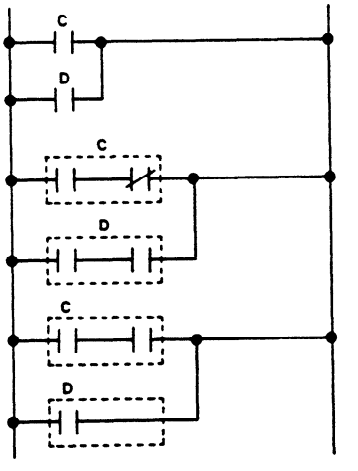
pc-s1-83-0029



EXAMPLES OF AND (A • B)

Figure 4-2. Series Logic (AND)

pc-s1-83-0057



EXAMPLES OF OR (C + D)

Figure 4-3. Parallel Logic (OR)

STR Begins (Starts) a new group of logic and stores current logic results into a Last In, First Out (LIFO) pushdown stack.

NOT Inverts the state of the referenced status to create a normally closed contact. NOT AND results in a normally closed series contact. NOT OR results in a normally closed parallel contact.

OUT Specifies the end of a string of logic by entering a coil. With a valid reference, such as OUT 19, this coil will reflect the output of the rung of relay logic by turning ON or OFF as dictated by the power flow. Outputs can be paralleled by entering additional OUT functions at the end of a rung of logic.

TMR Specifies a timer function to end a rung of logic. The timer requires a unique 6XX reference for storage. Two types can be programmed (seconds and tenths of seconds) depending upon the numerical preset (with or without decimal point) entered after the 6XX reference. For example, 0.9 or 9.0 seconds can be programmed, depending on the decimal point.

CNT Specifies a counter function to end two logic rungs. The two logic rungs required by this function are count and reset. Count, being the top rung of conditional logic. When all programmed conditions permit power flow, the counter will begin counting. The bottom rung is the reset rung and is programmed with the conditional logic required for resetting the counter. The counter also requires a unique 6XX reference for storage. Transition detection is a standard built-in function.

SR Specifies a Shift Register function to end three logic rungs (input, clock, and reset). The reference used with SR (for example, SR 410) is the first stage of this shift register. The last stage must be entered immediately after the SR and its reference. A shift register can contain a total of 128 steps or several shift registers can be programmed, each with a different number of steps, as long as the total of 128 steps is not exceeded.

MCS The MCS (Master Control Start) key specifies the beginning of a Master Control relay function. This provides an efficient method of programming for controlling large quantities of coils if a specific permissive condition is not satisfied.

MCR The MCR (Master Control Reset) key specifies the end of a Master Control relay function. A similar number of MCRs must be entered to terminate, one at a time, the Master Control Start functions entered. One MCR terminates only one previous MCS function.

SET Used with latches, shift registers, and coils. It specifies where latches are to be turned ON (set), shift register stages set to the ON state, or coils to be turned ON and not affected by internal reference 376 (disable all outputs).

RST Performs functions similar to the SET key for latches, shift registers, and coils, except it specifies when these references will be turned OFF (reset).

6. Editing Keys

These eight keys select the action required to modify either the stored logic within the CPU or the logic address being displayed. Those keys that can modify previously entered logic (that is, Delete and Insert) require a confirming key operation to ensure that the operation is to be executed. Thus, if they are accidentally depressed, the error can be corrected by depressing the CLR (Clear) key without actually affecting any entered logic. A description of each editing key is as follows:

DEL When logic is being displayed, this key (Delete) when included as the first keystroke of a two key sequence, will cause that single function to be removed (deleted) from the CPU memory. To be effective, after depressing Delete, the PRV (Previous) key must be depressed, which executes the delete operation.

INS This key (Insert) allows logic functions to be inserted between existing logic functions. The function or its address that is after the location at which the new function is to be placed, is displayed. Then the new logic is built followed by the Insert key (not the Enter key) and the confirming NXT (Next) key. The new logic that is inserted by this key sequence will be placed in memory immediately before the displayed function or address.

ENT The ENT (Enter) key is used to complete the entry of logic when initially building the CPU program or to replace an entire single word function. Logic functions are entered typically at the end of the existing logic.

CLR The CLR (Clear) key, when selected, clears the programmer of previously entered commands. If error codes are displayed, this key will acknowledge the error and return the programmer to its normal (cleared) function. When monitoring a program, depressing Clear will cause the display to indicate the memory address in lieu of logic functions. When the key sequence CLR, SHF, 3, 4, 8, DEL, NXT is entered, the entire contents of memory will be cleared.

NOTE

This key sequence should be used with caution, be sure that you want to clear the entire program. Remember, if single functions or groups of functions are to be cleared, the DEL key, followed by PRV should be selected for each function to be cleared.

SHF This key (Shift) locks all other keys to their shifted (upper label) functions and causes the SHF LED to be lit in the display area. The shift operation is ended by selecting the keys Clear or Enter. The SHF key must precede a numerical key or a group of numerals before selecting the numerical keys. For example to enter an open contact with input reference 12 as the first contact in a rung of logic, the key sequence would be STR, SHF, 1, 2, ENT.

SCH This key (Search) allows the entire program to be searched for specific logic functions. The logic function is defined by the logic keys (without Enter), then Search is selected. The memory will be searched from the current location until either a match is found or all memory is searched. Successive depressions of this key will cause repeated searches with memory wrap-around. An unsuccessful search results in error code E99 being displayed.

PRV When displaying logic or monitoring I/O state, selecting the PRV (Previous)B key causes the previous logic function or I/O status to be displayed. Additional depressions of this key cause the display to decrement until memory address zero is reached.

NXT When displaying logic or monitoring I/O state, selecting the NXT (Next) key causes the next logic function or I/O status to be displayed. Additional depressions of this key cause the display to increment until the end of memory is reached.

7. Shifted Functions

The Shift key, when selected, causes most keys to change their function to those marked on the face of the programmer directly above the corresponding keys. Normal unshifted functions are as placed on the keys themselves. Most of the shifted functions are used when entering numerical values (digits 0-9 plus the decimal point). When entering a program, the unshifted functions must be selected first (AND, OR, NOT, OUT, TMR, etc.), then the SHF is selected to enter the numerical portion of the program. The use of the other four shifted functions are as follows:

MON When in the Run mode, this function allows the user to monitor the status of I/O references in two successive groups of 8. The specified I/O reference is used to select the first 8 references and the next group in numerical sequence is also shown to provide a total of 16 real time statuses. The specified reference should be the first reference in a group of 8, for example, specify 10 to monitor the I/O group 10 to 17. If a reference other than the first one in a group is specified, monitoring of the I/O will default to the first reference in the group. After the reference (for example 043) is entered and displayed (for example 040) as data, the status of the 8 references in that group (for example 040-047) are displayed by the first 8 LED's (AND, OR, STR, etc.) in the logic display.

The next 8 references (e.g. 050) are also displayed and their status is indicated by the last 8 LED's (MCS, MCR, SET, etc.). These 16 LED's will be ON or OFF as the I/O assigned to these references is energized or de-energized. As the I/O changes, the state of the LEDs changes.

To display another group of I/O references, the PRV or NXT key can be selected to decrement (40, 30, 20, etc.) or increment (50, 60, 70, etc.) the group number and its associated references. References up to 577 can be displayed; there is automatic wrap-around from 570 to 000 (NXT) or 000 to 570 (PRV). The current values of timers and counters can also be monitored by entering TMR or CNT, SHF, 6XX (timer or counter reference) followed by MON (the Monitor Key).

WRITE This function operates with an audio tape cassette recorder or certain other peripherals to effect a transfer of the CPU's logic to the peripheral. Connect the device to the tape port with the audio cable supplied with each programmer or peripheral. Set the mode switch to LOAD and turn the device ON. To begin the transfer, select the WRITE key. This starts the writing of the CPU logic onto the cassette or other peripheral. For more detailed information on transferring data to peripheral devices, refer to the discussion of each peripheral.

READ This function operates with the audio tape cassette recorder or other peripheral to load a CPU's memory from the cassette or other storage device. Connect the device to the tape port with the audio cable supplied with each programmer or peripheral. Set the mode switch to LOAD and select the READ key. To begin the CPU loading, turn the device ON. This starts the reading of the tape and the loading of the stored program into the CPU memory.

CHECK This function operates with the audio tape recorder or other peripheral to verify proper program transfer. After a transfer is made, it should be read back similar to the READ above; however, the CHECK key must be selected instead of READ. The Check operation does not alter either the CPU logic nor the data in the peripheral. A data compare is made between the two sources of information to ensure that there has been no error in the recording process.

8. Data Operation Keys

These two keys are used during entering the data operations when programming the Series One Plus PC. These keys have no effect when this programmer (Catalog no. IC610PRG105) is used to program a Series One PC. The function of each of these keys is described below.

F This key must be depressed before a 2-digit value corresponding to the data operation or Function to be performed (for example, F50, F62, F74, F82, etc.). A complete list of the data operations and their Function number can be found in Chapter 5, Programming. The shift key does not need to be depressed immediately before the function numbers as must be done when selecting other numerical values when programming a Series One or Series One Plus PC.

R This key serves a dual function, in that it is used to select either a data register or a Timer/Counter accumulated value register, or a group reference number when programming data operations. A register is operated on as a word (16 bits) in the Series One Plus PC. When a 3-digit data register reference (400 to 577) is specified, two consecutive 8-bit registers are actually selected to write data to or read data from. For example, if R followed by the reference 410 is entered, registers 410 and 411 are selected for that data operation. If R 6 1 0 were entered, the accumulated value register for the timer or counter assigned to that reference would be specified in a data operation. Unused T/C references, 600 - 673 can be used as data registers.

A register can be specified to contain a Timer or Counter preset value. In this case the register reference (R XXX) is specified immediately following the Timer or Counter reference when programming a Timer or Counter.

A group reference is a 1, or 2 digit reference corresponding to the first 1 or 2 digits of a group of 8 consecutive discrete references. These references can be real I/O points, internal coils, or shift registers. For example, if the R key followed by 37 is entered, the reference is to discrete points 370 through 377. If R 5 is entered, the reference is to I/O points 050 through 067 (050-057 and 060-067).

9. **Peripheral Jack**
   This is a serial port which allows connection of an audio cassette tape recorder to record (save) the program stored in user memory, verify the contents of a tape against the contents of user memory, and load a program stored on tape into user memory. It is recommended that programs entered into user memory be saved on tape, once they have been verified as being correct. Note that when recording a Series One Plus program on tape, the contents of the data registers are not saved.

Program Checking and Error Codes

When entering ladder logic programs with the programmer, the CPU automatically performs many checks on the data and operations selected by the programmer. Functions entered are checked for proper key sequence, proper range of references entered, etc. Errors detected during these checks are indicated in the data display by the letter E followed by a two digit code (01-99). The CPU also performs a partial program error check any time that the PC is switched to the RUN mode. After entering a program, a manual error check should be performed, which checks the entire program.

Table 4-1 summarizes the meaning of each error code, its cause, and possible methods of clearing the error. The use of the programmer to enter logic is documented in Chapter 5 as part of programming. However, there are many other valuable functions it provides which are shown in the following table:

Table 4-1. Error Code Definitions

	Applicable Mode					
Code	Run	Prog	Load	Significance	Cause	Corrective Action
E1	X	X	X	Incorrect Operation	Operator attempted to perform illegal operation such as changing program in RUN mode.	Examine operation. Depress CLR. Reinitiate proper function.
E2	X			Fault in Program Structure. Series One.	CPU has detected error in program when placed into RUN mode. Example: Input module reference used as coil	Go to Program mode. Depress CLR. Address of faulty logic will be shown. Depress NXT to display content.
E2	X			Fault in Program Structure. Series One Plus.	CPU has detected error in program when placed into RUN mode. Example: Input module reference used as coil.	Go to Program mode. Depress CLR-SCH-CLR. Address of faulty logic will be shown. Depress NXT to display content.
E3	X			Stack Capacity Exceeded	More than eight status levels attempted to be stored in pushdown stack.	Go to Program mode. Depress CLR. Programmer will display location of first 9th STR error. Examine logic and reprogram as necessary.
E5	X			Duplicate Coil Reference	Coil (output, internal, timer, or counter) used as an OUT more than once.	Go to Program mode. Depress CLR. Programmer will display location of second coil of pair using same reference. Enter another coil reference.

Table 4-1. Error Code Definitions - Continued

Code	Applicable Mode			Significance	Cause	Corrective Action
	Run	Prog	Load			
E6	X			Incomplete Master Control	More MCR references than MCS in program.	Go to Program mode. Depress CLR. Programmer will display first unmatched MCR. Correct program by deleting MCR or adding MCS.
E7	X			Incomplete Counter or Shift Register.	All control lines not provided to one or more Counters and/or Shift Registers.	Go to Program mode. Depress CLR. Programmer will display errant function. Add required reset, clock or clear lines.
E8		X		Incorrect Operation.	Operator attempted to write instruction on second word of a 2-word instruction.	Depress CLR.
E9	X			Incomplete Logic.	Relay ladder line not connected to coil; relay contact(s) left incomplete or hanging.	Go to Program Mode. Depress CLR. Programmer will display first unfinished logic element. Add logic to tie this element into stored logic, or delete element(s) to remove incomplete logic.
E11		X		Memory Full.	Operator attempting to add logic to CPU already at limit.	Depress CLR. Restructure program so that logic limits will not be exceeded.
E21	X	X		Parity Failure.	CPU has detected a fault in the parity structure of its internal memory.	Go to Load Mode. Depress CLR. Reload memory from previously recorded tape or clear entire memory and reload manually. If BATT light not ON and fault cannot be cleared, replace CPU module.
E25			X	Faulty Comparison.	External device such as tape cassette has content that does not agree with CPU memory.	Depress CLR. Verify correct program number or tape. If correct, either re-record tape or reload CPU.
E28			X	Weak Record Signal.	Playback Signal level, such as from tape recorder, is below acceptable level.	Adjust volume level on tape recorder or other peripheral device. If ON steady for extended period of time, restart function to obtain reliable operation.
E99	X	X		Unsuccessful Search.	Search function has reviewed all memory and has not located required.	Depress CLR. To cause an additional search, re-enter function and restart.

Operation Sequences

An understanding of the basic PC operation sequences is necessary in order to effectively and efficiently enter ladder diagram programs. You should be familiar with the use of each key, alone and in sequence

with other keys. The programmer is an excellent tool for program entering, editing and monitoring. Table 4-2 lists the various operations, the keystrokes required to enter those operations, and the mode or modes in which the operation can be performed. Each of the modes is indicated by a letter; R (RUN), P (PROGRAM), or L (LOAD).

Table 4-2. PC Operation Sequences

Operation	Keystrokes or Operation Sequence	MODE		
		R	P	L
Insert or Remove Key		X		X
Clear all user memory	CLR SHF 3 4 8 DEL NXT		X	
Display present address	CLR	X	X	
Display present function	NXT	X	X	
Next function	NXT(After previous keystroke)	X	X	
Previous function	PRV	X	X	
Go to address 0000 in program memory	SHF NXT	X	X	
Go to specific address	SHF (address) NXT	X	X	
Go to next address	After previous entry NXT	X	X	
Clear displayed function	CLR	X	X	
Search for a specific function	(Function) SHF (Ref. No.) SCH NXT	X	X	
Search for a specific reference number	SHF (Ref. No.) SCH NXT	X	X	
Insert function before the displayed function (or address)	(Function) SHF (Ref. No.) INS NXT		X	
Cancel insert	CLRSHF INS		X	
Delete a function	(address) DEL PRV		X	
Check program for errors. If no error detected, the next available address is displayed.	CLR SCH	X	X	
Turn Timer/Counter ON Turn Timer/Counter OFF	TMR or CNT SHF 6XX SET TMR or CNT SHF 6XX RST	X		
Change preset value of a Timer or Counter	SHF (preset value) ENT	X		
Monitor ON/OFF status of a group of 16 consecutive references (I/O, internal coils, Shift Register coils	SHF (Beginning Ref. No.) MON	X		
Monitor Timer or Counter accumulated value	SHF (T/C No.) MON To monitor the previous or next T/C enter, PRV or NXT	X		
Monitor ON/OFF state of any coil or contact	The ON OFF LED turns ON or OFF to indicate the state of the displayed reference.	X		
Force a reference ON (will be overridden by user logic)	SET SHF (Ref. No.) ENT Reference can be Input, Output,Shift Register, Timer or Counter	X		

Table 4-2. PC Operation Sequences - Continued

Operation	Keystrokes or Operation Sequence	MODE		
		R	P	L
Force a reference OFF (will be overridden by user logic)	RST SHF (Ref. No.) ENT	X		
Enter a function into program memory	(Function) SHF (Ref. No.) ENT		X	
Edit a program	Same as above. Select address and enter change		X	
Transfer data to tape	(Optional program ID) SHF WRITE			X
Load program memory from tape	(Optional program ID) SHF READ			X
Verify data on tape or in PROM writer RAM against program memory	(Optional program ID) SHF CHECK			X
SERIES ONE PLUS ONLY				
Monitor contents of Data Registers (1)	R (Register Ref) SHF MON	X		
Monitor next register	NXT	X		
Monitor previous register	NXT	X		
Enter or change the contents of displayed register. A 4 digit BCD value can be entered (16-bits).	SHF XXXX ENT When the data contents are displayed, this sequence will overwrite the current contents of the register	X	X	
Enter or change a password (2) (3)	CLR SHF 9876 DEL SHF XXXX ENT NXT	X	X	
Log in sequence (3)	CLR SHF 5678 DEL SHF (Password) ENT NXT	X	X	
Log out sequence (3)	CLR SHF 1234 DEL NXT	X	X	

1. When the MON key is selected, the ADDRESS DATA display shows the address of the specified register. To display the data contents of the register, depress the MON key again.
2. 9876 is a fixed sequence. The password (XXXX) can be any numerical value between 0001 and 9999. The value 0000 is equivalent to no password. All programmer functions are operable when the password is 0000.
3. Password information also applies to the Series One Model E PC.

The above table provides a convenient reference to the programmer keystrokes required for the various PC operations. A more detailed description of each operation is provided on the following pages or in Chapter 5, Programming.

Monitor CPU Logic - This sequence of operation provides the steps required in order to observe the contents of user memory. You can either step forward or backward in user memory. With the Programmer installed and the mode switch in the Run or PRG (Program) position, observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Depress the NXT key, the logic content of memory location zero will be shown (beginning of memory or scan).

3. Successive depressions of the NXT key will cause the programmer to step through the stored program in the order that the program is scanned, from address 0.0.0.0. to the last address in the program. At any time, the CLR key can be depressed to display the address of the logic then being viewed.
4. An additional depression of the NXT key will restore the display to the logic content.
5. At any time, depressing PRV will cause the logic of the previous (closer to zero) memory location to be displayed.
6. Successive depressions of PRV will cause the programmer to step backwards through the stored program in reverse of the order that the program is scanned. At location 0.0.0.0., PRV has no effect.
7. If by successive depressions of NXT, the end of the actual program is passed, the display will show End. With each successive selection (with the NXT or PRV keys) of an unprogrammed or empty memory word, the address of the new location will flash in the display for 1/4 to 1/3 of a second prior to going to End.

Search CPU Logic - In the event that you wish to quickly find a particular logic element (programming step) in user memory, this sequence of operation allows you to do so. After installing the programmer, with the mode switch in the RUN or PRG position, observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the logic function whose location is to be searched for. For example, select AND, SHF, 1, 0, 5 (AND 105). Do not select ENT key.
3. Select the SCH key to begin the search. If the logic function is not found, error code E99 will be displayed.
4. If a match is found, the display will indicate the first memory address containing the desired function. Depressing NXT will cause the logic at that address to be displayed.
5. Successive depression of SCH, while the memory address is being displayed, will cause additional searches to occur from the current location.
6. As long as one match is found, the search will not stop at the end of memory, but will continue with memory address zero until a match (possibly the same location) is again detected.
7. To find the first empty memory word, depress CLR to obtain an address location. Then select SCH (search for zero content) to begin the search for the first available location.

Alter One Logic Element - This sequence of operation allows you to change the contents of a particular location in user memory. After installing the programmer, place the mode switch in the PRG position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Move the display to the element to be altered using the NXT or PRV key or Search function.
3. Enter the new logic element, for example: OR, SHF, 2, and 5 (OR 25).
4. Select the Enter (ENT) key to cause the change to occur. The new logic element you have entered will take the place of the previous logic at that memory location. The next address will be automatically displayed.
5. If the new element is not to be entered or an error has been made in its construction, depressing the Clear (CLR) key will cancel the new logic and return the display to the address of the examined element.

Delete One Logic Element - This sequence of operation allows you to remove one logic element from the program in user memory. After installing the programmer, place the mode switch in the PRG position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Move the display to the element to be deleted using the NXT or PRV key or the Search function.
3. Select the DEL key. Notice that the Address/Data display has a small "d" in the left digit of the display.
4. To confirm that the Delete operation is to be executed, select the PRV key. The next address will be displayed after the Delete is performed. The remaining user logic will automatically move back one address location (nearer to 0.0.0.0.) to fill the empty memory.
5. To cancel the Delete operation, select the CLR key (before selecting DEL). The display will revert to the element being considered for deletion.

Clear All Memory - This programming sequence should only be used when the entire contents of logic memory are to be cleared. After installing the programmer, place the mode switch in the PRG position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Select the key sequence CLR, SHF, 3, 4, 8.
3. Select the DEL key; the display will change to.
4. To execute the clear function and cause all logic elements to be removed from user memory, depress the NXT key.
5. To cancel the clear function, the CLR key can be depressed before depressing NXT.

Insert One Logic Element - This sequence of operation allows you to insert one logic element between two existing program steps in the use program. After installing the programmer, place the mode switch in the Program position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Move the display to the element that will be after the location at which the new element is to be entered. This can be done by using the NXT or PRV key or the Search function.
3. Enter the new logic element, for example; AND, SHF, 1, 0, and 4 (AND 104).
4. Select the Insert (INS) key to cause the change to occur. Notice that the address display has a small "i" in the left digit of the display.
5. A confirming keystroke is required to ensure that the insert action by the operator is valid. To confirm the insert, select the NXT key. After the insert is performed, the display will show the address of the next logic element.

Monitor I/O Status - This operation sequence allows you to monitor the status (ON or OFF) of references. A total of 16 I/O references can be monitored at any one time, beginning with the lowest address in the group with the reference selected by the operator. Each reference is within a group of 8 references. The I/O status of the group containing the selected reference, plus the next higher group of 8, is displayed. After installing the programmer, place the mode switch in the RUN position. Observe or perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter any reference to be monitored. For example, to monitor the real time status of references 020-027, or any one reference within that group, the following keys can be selected: SHF, 2 and 0.

3. Select the Monitor function (MON). Note that the shift is still in effect (selected in previous step) causing the RST key to select the monitor function.
4. The display will revert to]-] followed by the lowest reference (e.g. 020) in that group. The I/O references can be for a 4, 8, or 16 point module. If the module is a 4-point module, the status of the first 4 I/O points are real world outputs and their operating status will be displayed. The 4 higher references cannot be used as real world outputs, but can be assigned to internal coils. The 4 monitor LEDs normally assigned to the 4 higher references in this group will always be OFF.

   The status of an 8 point module (for example, 030 to 037) is indicated by the first 8 LED's (AND, OR, STR, ... SR) and the next module's status, if an 8 point (for example, 040-047) will be indicated by the last 8 LEDs (MCS, MCR, SHF....7). In the case of a 16-point module, the status of all 16 points will be consecutively displayed.
5. Depressing the NXT or PRV keys will cause the address display to increment or decrement to the next or previous group of 8 statuses or module, if in an expansion rack. All discrete references can be examined. The display returns to zero after the highest reference has been examined.

Monitor Timer or Counter Status - This operation sequence allows an operator to monitor the current accumulated value of a timer or counter. After installing the programmer, place the mode switch in the RUN position. Observe or perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the timer or counter reference to be monitored. For example, to monitor the operating status of timer 601, enter SHF, 6, 0, 1. If a counter had been assigned reference 601, you would then be monitoring the status of counter 601. The valid references for timers or counters are 600 to 677. References 674, 675, 676, and 677 are reserved for use with the Thumbwheel Interface unit (Series One or One Plus) or the Timer/Counter Setpoint Unit (only for Series One Plus). Remember, each valid reference can be assigned to only 1 timer or 1 counter.
3. Select the Monitor function (MON). Note that the shift selected in the previous step is still in effect causing the RST key to select the monitor function. If the selected reference is not used in the program, error code E01 will be displayed.
4. The display will contain the current content (accumulated value) of the selected timer or counter. Timer values will be displayed in tenths from 000.1 up to 999.9 and counter values will be 0001 to 9999. The Logic Display will also show the two least significant digits of the timer or counter reference (for example, 01 for timer or counter 601).
5. The NXT and PRV keys move the display to adjacent timer or counters. Any timer or counter not actually used in the logic cannot be displayed.

Display a Specific Address - This operation sequence allows you to select and display a specific memory address (location) and the logic content of that address. After installing the programmer, place the mode switch in the RUN or PRG position. Observe or perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the memory address to be observed. For example, if the logic contained in address 36 is to be observed, SHF, 3 and 6 would be selected.
3. The NXT key is then selected and the display will contain the selected address. To display the content of this memory address, the NXT key is depressed a second time.
4. At any time, selecting SHF then NXT will cause the display to go to address 0.0.0.0.

Monitor Data Register Contents *(Series One Plus only)* - This operation sequence allows an operator to monitor the current contents of any data register. After installing the programmer, place the mode switch in the RUN position and perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the reference for the data register to be monitored. Valid data register references are 400 through 577 and 600 through 673. For example, to monitor the contents of data register 452, enter the key sequence R 4 5 2 MON.
3. The display will contain the address of the selected data register.
4. To display the contents of the selected data register, depress the MON key a second time. The display will now contain the current contents (4-digit BCD value) of the selected register.
5. The NXT and PRV keys move the display to adjacent data registers.

Change Contents of a Data Register *(Series One Plus only)* - This operation sequence allows an operator to change the current contents of any data register. After installing the programmer, place the mode switch in the RUN position and perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the reference for the data register to be monitored, following the steps in the previous operation.
3. After depressing the MON key a second time and the current contents of the data register are displayed, the contents may be changed if desired.
4. To change the current contents of the displayed data register, enter the sequence SHF XXXX ENT, where XXXX is a 4-digit BCD value having a valid range from 0000 to 9999. The new value entered will write over (replace) the value originally displayed.

Enter or Change a Password *(Series One Model E and Series One Plus)* - This operation sequence allows an operator to enter a password or change a previously entered password. When a password is entered, all programmer functions are disabled, except for the monitor functions. This prevents unauthorized access to the program in a Series One Plus PC. After installing the programmer, place the mode switch in the RUN or PRG position and perform the following actions:

1. To enter a new password or change a previously entered password, use the following key sequence:

   CLR SHF 9876 DEL SHF XXXX ENT NXT

2. 9876 is a required sequence. Your password (XXXX) can be any numerical value from 0001 through 9999. The value 0000 is equivalent to no password, all programmer functions are operable when the password is 0000. If you do not have a requirement for password security, use 0000.

To have access to all programmer functions when a password is in effect, a LOG IN sequence must be entered by the operator. After performing any necessary operations with the programmer, the operator must then enter a LOG OUT sequence to prevent any unauthorized access to the program. The LOG IN and LOG OUT sequences are shown below.

Access to Programmer Functions with Password in Effect*(Series One Model E and Series One Plus)*
After installing the programmer on a Series One Plus PC having a password in effect, place the mode switch in the RUN or PRG position and perform the following actions:

1. To LOG IN, enter the key sequence:

   CLR SHF 5678 DEL SHF XXXX ENT NXT

2. The numerical value, 5678 is a required entry. XXXX is the password that had been previously selected by the operator.

3. The operator can now monitor or change the program as required. When not using the programmer, the operator should then LOG OUT to return the programmer to password security.
4. To LOG OUT, enter the following key sequence.

   CLR SHF 1234 DEL NXT

5. Verify that the programmer functions have been disabled.

NOTE

If the user should for any reason forget the password entered into the PC, use of most programmer functions would not be possible. If this should happen, contact the GE Fanuc Automation service center in Charlottesville, Virginia for assistance.

Forcing References - The operation sequences described in this paragraph allow you to force an Input, Output, Shift Register, Timer, or Counter reference either on or off. Forcing the state of I/O references provides a convenient method of testing the operation of field devices and debugging the logic in the user program. If an input or output is forced on or off, it will remain in the forced state for 1 scan of the CPU. The programmer must be in the RUN mode to force any reference. After installing the programmer, place the mode switch in the RUN position. Use the following steps to force references.

1. The programmer will display address zero indicated by four digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter one of the following sequences to force a reference either on or off as required:
   - To force a specific reference ON, enter the sequence: SET, SHF, XXX (Reference), ENT
   - To force a specific reference OFF, enter the sequence: RST, SHF, XXX (Reference), ENT
3. Repeat the above operation for other references to be forced.

WARNING

When forcing input points with the set or rst sequence, the actual state of the input may be overridden. If the forced set or rst occurs in the user logic program before the input is checked in the same i/o scan, the set or rst state will take precedence and could cause an output to be turned on or off at the wrong time.

Operation With Peripheral Devices

Several peripheral devices are available for use with a Series One or Series One Plus PC. The Programmer is required for operation with the tape recorder, when recording user programs. The tape recorder connects to the Programmer through the Programmer's tape port. The tape port is located to the right of the mode switch and is labeled TAPE. The rest of this chapter describes the operation of these peripherals, which are listed below:

Audio Tape Recorder	Various models
Printer Interface Unit	Catalog Number IC610PER151
PROM Writer Unit	Catalog Number IC610PER154

Tape Recorder Operation

Most audio tape recorders with auto-level control can be used with a Series One or Series One Plus PC. It is recommended that the recorder also be equipped with a counter to allow multiple programs to be recorded on tape. Units such as General Electric model 3-5148 have been tested and found fully compatible with the Series One family of PCs. This recorder is packaged with an interface module (not

required for the Series One or Series One Plus PCs) and can be ordered as Catalog Number 3-5156. The tape recorder allows three functions to be performed: (1) record a program onto tape, (2) load a CPU or peripheral from tape, and (3) verify the content of a tape. The operation of each of these functions is described below in a step-by-step manner. All logic memory is recorded on tape.

Tapes created on Series One, Series One Model E or Series One Plus PCs can be loaded into any Series One, Series One Model E, Series One Plus or Series One Plus 3.7K PC Tapes created on the Series One Plus 3.7K PC can only be loaded into another Series One Plus 3.7K PC.

A 2.5 foot (0.75 meter) audio cable (Catalog number IC610CBL151), which is gray with a red tracer, is supplied with the programmer. This cable is used only with a tape recorder and connects it to the tape port on the programmer.

Recording A Program

1. Install the Programmer and apply AC power to the PC.
2. Turn the mode switch on the Programmer to the LOAD position.
3. Apply AC power to the tape recorder. Verify presence of the write protect tab on a cassette and insert the cassette. If the write protect tab is not in place, data entered on the tape may be inadvertently erased.
4. Adjust the tone control to its highest position.
5. Connect the Programmer (TAPE port) to the tape recorder (MIC input) with the 2.5 ft. (0.75 m) audio cable (gray with red tracer).
6. Rewind tape to the beginning or to the desired record position if multiple programs are to be placed on one tape. Programs require approximately 1.5 minutes (700 words), 4 minutes (1724 words) or 8 minutes (3.7K words), as applicable, of tape per program.
7. For identification of a program, if desired, enter a four digit number (0000-9999) on the Programmer. When tape is accessed later to load the CPU, this number can be used to identify the correct program prior to altering CPU data. If a program number is not as expected, the operator can terminate the load operation and get the correct tape without loss of existing program nor delay incurred by loading a wrong program. However, this identification number is optional.
8. Begin the tape recorder operation by depressing the RECORD button (and PLAY if required by the tape recorder).
9. Depress the WRITE key on the Programmer. The record operation will now begin.
10. If after following all instructions, reliable operation cannot be obtained, try operating the recorder with batteries.
11. When the record is complete, the Programmer will display End in the Address/Data display and the ON/OFF LED will be off. Stop the recorder and note the counter position so that the amount of tape used for that program can be determined.
12. Depress the CLR (Clear) key on the Programmer to end the record operation.
13. It is recommended that the tape be rewound to where the record began and that the Verify operation described below be performed to ensure data integrity.

Verifying A Program

1. Install the Programmer and apply AC power to the PC.
2. Turn the mode switch on the Programmer to the LOAD position.
3. Apply AC power to the tape recorder and insert the cassette containing the program to be verified.

4. Adjust the tape recorder's volume control to the maximum setting. Adjust the tone control to its highest setting.
5. Connect the Programmer (TAPE port) to the tape recorder (EAR input) with the audio cable (gray with red tracer).
6. Rewind the tape to the beginning of the previously recorded program. The tape can also be on the blank area prior to the program, but not on another program. Enter the program identification number (if previously recorded).
7. Depress the CHECK key on the Programmer to select the verify operation.
8. Start the tape recorder by depressing the PLAY button. The verify operation now begins.
9. Any errors detected during the verify operation are indicated by an error code being displayed on the Programmer's Address/Data display. Error code E21 indicates that the tape has an internal parity error. E25 indicates a mismatch between the content of the tape and the CPU logic memory. E28 indicates that the play level is wrong and the verify operation should be stopped, volume adjusted, and the operation restarted (from step 6 above).
10. Setting of the volume control is critical for proper operation. The error code displayed for an incorrect (low) volume control setting is E28. Figure 4-4 illustrates the area of the volume control available for a proper setting.

pc-s1-83-0065

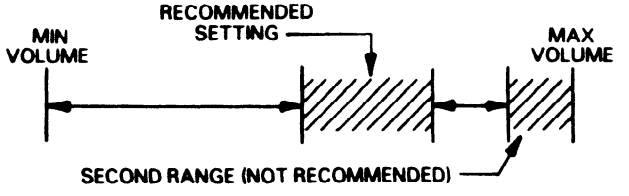


Figure 4-4. Volume Control Range Setting

With some recorders, there are two ranges where the signal level appears to be acceptable, one near the middle and one near maximum volume. The setting near maximum volume should not be used. The CPU will indicate that it is acceptable; however, an unacceptable amount of clipping distortion may occur in this area with some recorders.

11. Find the correct position for the mid-range of the acceptable volume control during the beginning or header portion of the tape. Some experimenting may be necessary. The duration of time for the header is about 12 seconds. It is important to choose the lower of the two ranges for the volume control setting if they both exist (see 10 above). For the recommended GE Fanuc Automation recorder this is at about 80% of the full maximum setting. Mark the proper setting with paint or some other method of identification.
12. If the volume control has been correctly set before the end of the header, the programmer display will be blank, and the lower right number 7 LED will turn on dimly. Before the end of the header the LED will turn off. A few seconds later, F will be displayed, indicating that the program has been found.
13. During the adjusting process in 11 above, the data from the tape may not be valid if the adjustment is not performed quickly enough. The tape loading should be repeated with the correct volume control setting. To clear the CPU to restart the loading, it is necessary to either power-down the CPU or remove the Programmer from the CPU, then reattach and depress the Clear key.

14. When the verify is complete without error. the Programmer will display End in the Address/Data display.

15. Stop the recorder and depress the CLR (Clear) key on the Programmer to end the verify operation.

16. The verify operation will require approximately the same time as the record operation.

Loading A Program

1. Install the Programmer and apply AC power to the PC.
2. Turn the mode switch on the Programmer to the LOAD position.
3. Apply AC power to the tape recorder and insert the cassette containing the required program.
4. Adjust the volume control to the setting determined during the verify operation. Adjust the tone control to its highest setting.
5. Connect the Programmer (TAPE port) to the tape recorder (EAR input) with the audio cable (gray with red tracer).
6. Rewind the tape to the beginning of a previously recorded program. Tape can also be on the blank area prior to the program, but not on another program. Enter the program identification number (if previously recorded).
7. Select the READ key on the Programmer to establish the load operation.
8. Start the tape recorder by depressing the PLAY key. The load operation now begins.

   If the CPU detects a program number different than the one entered in step 6, the programmer will beep and the display will show PA .

9. If the wrong program has been selected, the load operation can be aborted by stopping the recorder and powering-down the CPU or remove the programmer from the CPU, then reattach and depress the CLR key.
10. Any errors detected during the load operation are indicated by an error code being displayed on the Programmer's Address/Data display. Error code E21 indicates the tape has an internal parity error. A steady E28 indicates the play level is wrong and the load should be stopped, volume adjusted, and the operation restarted (step 6 above).
11. When the load is complete with no errors, the Programmer will display End in the Address/Data display and the ON/OFF LED will be off. Stop the recorder and depress the CLR (Clear) key on the Programmer to end the load operation.
12. The load operation will require approximately the same time as the record operation.

Printer Interface Unit

The Printer Interface Unit (catalog number IC610PER151) provides an interface between a Series One or Series One Plus PC and a printer for the purpose of providing a convenient means of obtaining a hard-copy printout of the program residing in the PC's user memory. It can also be used with a Series One Junior PC. The format of the printout is switch selectable and can be either Boolean (mnemonic) or ladder diagram format. Many readily available, inexpensive printers can be used with the Printer Interface Unit.

A 6' (2m) Printer Interface cable and an external power supply cable are included with the Printer Interface Unit. Printer Interface Unit Specifications are listed below in table 4-3

Table 4-3. Printer Interface Unit Specifications

Operating Temperature	0° to 60° C (32" to 140° F)
Storage Temperature	-10° to 70° C (14° to 158° F)
Humidity (non-condensing)	5 to 95%
Required Operating Power	+5 V dc + 5%, 300 mA (minimum) (Supplied either internally from the CPU or from an external power supply)
Dimensions	5.7" x 4.7" x 1.5" (145 x 120 x 38mm)
Weight	11.68 oz (330 g)
Printer Interface	Centronics (Parallel)
Printing Capacity (maximum)	Ladder Diagram Listing 13 contacts and 1 coil per line 16 lines per page Boolean Listing 200 steps per page (4 lines with 50 steps in each line). 700 steps maximum

Table 4-4 lists the requirements that a printer must meet for use with the Printer Interface Unit.

Table 4-4. Printer Requirements

- Must have a Centronics interface
- Able to generate ASCII character code 7CH (Hexadecimal) as a "/" (slash).
- Must respond to control codes: OE H (SO) - Expanded print ON
  OF H (SI) - Compressed print ON
  12 H (DC2) - Compressed print OFF
  14 H (DC4) - Expanded print OFF
- Must be capable of printing 132 columns; however, if an 80 column printer can respond to the SI (OF H) control code to allow 132 or more characters per line, it can be used. This type of printer, when used with the Printer Interface Unit, will print compressed characters. Choice of normal (132 column) or compressed (80 column) print is switch selectable.
- The following printers have been tested for operation and can be used with the Printer Interface Unit.
  General Electric Personal Computer Printer, model 3-8100
  Epson model RP-100
  Hewlett Packard Thinkjet, model HP 2225C
  IBM Personal Computer Graphics Printer
  Seiko model GP-500

Hardware Description

The Printer Interface Unit is a compact unit that attaches to the Series One or Series One Plus PC. **Electrical and physical connections to the PC are** made through **a 26-pin** connector **located** on the back **of the Printer Interface Unit. The Printer Interface Unit is attached to the PC by placing its 26-pin connector directly over the mating connector on the PC and gently pushing down on the unit until it is securely in place.**

Connection from the Printer Interface Unit to the selected printer is **made through the** Printer **Interface Cable, IC610CBL152 to a 24-pin connector on the** front of the unit. Power **to the unit can be supplied directly through the rear panel** connector **from** the CPU power supply or **from** an external power **source**

capable of supplying +5 V dc @ 300 mA. The power source, either internal (INT) or external (EXT) is selected by a 2-position switch located on the rear panel. Connection to an external power source is made through a 3-wire cable supplied with the Printer Interface Unit.

The sequence for operation of the Printer Interface Unit is initiated by depressing pushbutton switches on the front panel. Two indicator lights on the front panel provide a visual status of the Printer Interface Unit operation. There are also 2 indicators that provide operating status of the PC. Figure 4-5 is an illustration of the Printer Interface Unit showing-the features mentioned above.

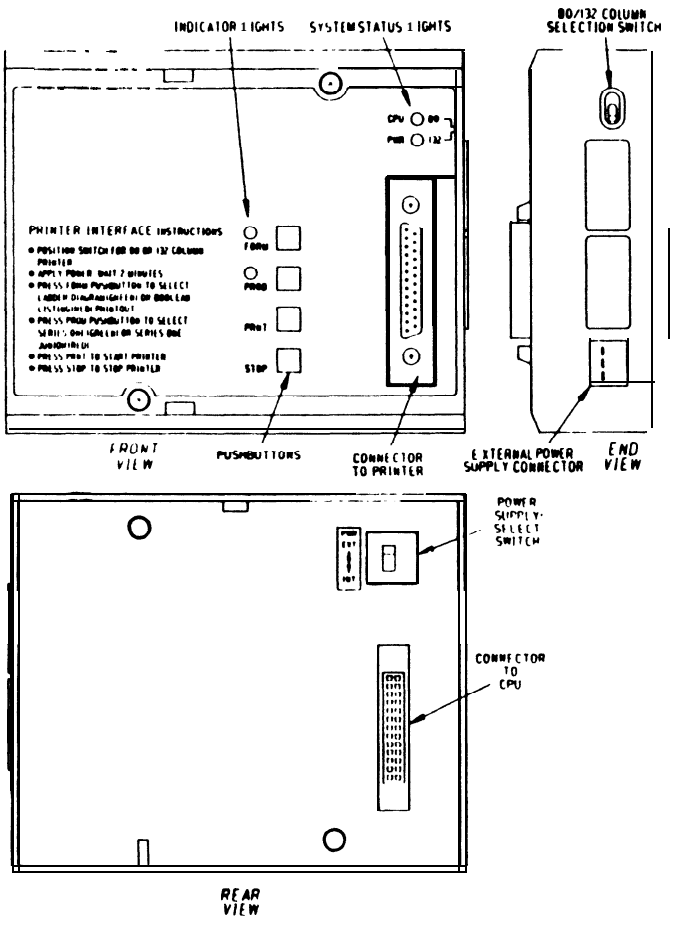


Figure 4-5. Printer Interface Unit

Hardware Features

The Printer Interface Unit front panel has two LEDs located in the upper right comer used for visual indication of system status. The purpose of the indicators is described below.

CPU	The red CPU LED is an indication of the operating status of the CPU in the PC. This is identical to the CPU LED on the PC.
ON	CPU failure has been detected.
OFF	CPU operation is normal.
PWR	The green PWR LED is an indication of the status of dc power being supplied to the Printer Interface Unit.
ON	If power is being supplied by the Series One or Series One Plus internal power supply, tbis indicates that +5 V dc is being properly produced by the supply. If the Printer Interface Unit is being powered from an extemal source, the +5 V dc being supplied is within the specified tolerance.

GEL90842

OFF 5 V dc not being supplied or not in tolerance.

The 24-pin connector located on the lower right of the front panel, provides a connection from the Printer Interface Unit to the selected printer through the Printer Interface cable, IC610CBL152.

Immediately to the left of the connector are 4 pushbuttons used to initiate operation of the Printer Interface Unit to get a hard copy printout. There are also 2 LEDs used as status indicators during the set-up procedure.

FORM This pushbutton is used to select the fomat of the printout, either a ladder diagram or Boolean listing of the user program. The pushbutton is an alternate function switch. Each time it is depressed, the selected printout format will change.

As the pushbutton is depressed, the color of the LED will alternate between green and red. The LED, when green, indicates a ladder diagram printout; when red, indicates a Boolean listing printout.

PROD This pushbutton is also an alternate function switch. Each time it is depressed, either a Series One Junior PC or the Series One/Series One Plus PC is altemately selected as the program listing source. The selection must agree with the PC to which the Printer Interface Unit is attached.

As this pushbutton is depressed, the color of the LED will alternate between green and red. The LED, when red, indicates selection of Series One Junior, when green, indicates selection of Series One/Series One Plus.

PRNT When depressed, this pushbutton causes the printer to begin printing the user program in the selected formats.

STOP When depressed, this pushbutton causes the printing operation to stop.

80/132 Column Selection Switch

On the right side-panel is a 2-position toggle switch used for selection of either 80 column printing format (compressed print) or 132 column printing format (normal print). The 80 column compressed print format is typically used with printers designed for use with personal computers. The selected printer column format corresponding with the switch position is printed on the right edge of the front panel, either 80 (towards the top of the unit) or 132 (towards the bottom of the unit). If desired, the 80 column compressed print format can be selected for use with a 132 column printer. The unused space to the right, beyond the 80th column, could be used for adding comments.

External Power Supply Connector

A connector located on the lower right side of the unit provides the connections to an external power supply. A mating 3-pin connector with attached wires which are 3 feet (lm) in length, is provided with the Printer Interface Unit for connection to the external supply. The color code for the external power supply cable and specifications for the power supply are as follows:

White	**+5 V dc, ± 5% (rated at 300 mA minimum)**
Black	Power **supply logic ground**
Green	**Common system ground**

Power Supply Select Switch

This is a two-position switch located on the bottom of the unit, directly above the 26-pin connector. This switch is used for selection of either internal or external dc power for the Printer Interface Unit. The top switch position is labeled EXT (External) and the bottom position is labeled INT (Internal). If the Printer Interface Unit is to be powered by an external +5 V dc power supply, the Power Supply Select switch must be set to EXT.

Sequence of Operation

As a convenience to the user, instructions for using the Printer Interface Unit are printed on the front panel of the unit. The sequence of operation is described below. If a Series One Plus program is to be printed and a password is in effect, the password must be changed to 0000 before mounting the Printer Interface Unit.

Power-up Sequence

The following power-up sequence should be followed after the Printer Interface Unit has been properly configured.

1. Power to be supplied by the internal PC supply or an external power supply.
2. Place EXT/INT switch in the INT or EXT position as required.
3. Turn off power to the PC.
4. Mount Printer Interface Unit onto the PC.
5. Attach Printer Interface cable from connector on front panel of unit to printer.
6. Turn on power to the PC.
7. Turn on power to the external power supply, if used.

User Program Transfer From PC To Printer Interface Unit

Immediately after the power-up sequence has been completed, the user program stored in the PC's user memory will automatically begin transferring to a buffer memory in the Printer Interface Unit. This program transfer will take about 1.5 minutes. When the program has been successfully transferred, the FORM and PROD LED indicators will turn on green. If the program transfer is not successful, the LED indicators will either flicker on and off red or neither LED will illuminate. If after 2 minutes, neither LED turns on, repeat the power-up procedure from the beginning of the sequence.

Selection of Printout Format and Type of PC

Select the printout format, either ladder diagram or Boolean, and the PC model, either Series One Junior or Series One/Series One Plus by depressing the FORM and PROD switches as shown in the following table.

Table 4-5. Format and PC Selection

FORM		PROD	
PRINTOUT TYPE	LED ON	**PC**	LED ON
Ladder Ladder Boolean Boolean	Green Green Red Red	series one/be Plus Series One Junior series one/one Plus Series One Junior	Gren Red Green Red

Start Printer Operation

Depress PRNT pushbutton. The ladder diagram or Boolean program listing will begin to print and continue printing until the complete program has been listed or has been stopped by the operator.

If at any time, the program listing is to be stopped, depress the STOP switch. When this is done during a ladder diagram printout, the printout will stop. When the STOP switch is depressed during a Boolean

listing printout, the Boolean listing printout will stop, the printer will formfeed, and the complete OUTPUTS USED TABLE will be printed.

Printing Of Error Messages During Ladder Diagram Listing

If any errors in the printing process are detected by the Printer Interface Unit during printing of a ladder diagram listing, an error message will be printed and the printing may stop, depending on the type of error. Table 4-6 lists the error messages and their definitions.

Table 4-6. Ladder Diagram Listing Error Messages and Definitions

ERROR MESSAGE	DEFINITION
ROW OVER	One rung of logic exceeds 16 lines.
COLUMN OVER	More than 13 circuit elements in line
STACK ERROR (SR)	Clock or Reset line not proved in Shift Register logic.
STACK ERROR (CNT)	Reset line not programmed in Counter logic.
STACK OVER	Pushdown stack using AND STR and OR STR functions exceeds 8 levels.
STACK OVER (MCS)	Levels of MCS control exceed 8.
MC ERROR	MCR functions exceed MCS functions.
PROGRAM ERROR	Any error not listed in tbis table.

NOTE

When the ROW OVER or COLUMN OVER error messages are printed, the printout of the ladder diagram will continue. **When any** other error messages are printed, a **PRINT STOP** message will be printed, paper will feed **and** printing will stop.

Printing Of Error Messages During Boolean Listing

If any errors in the printing process are detected by the Printer Interface Unit during printing of a Boolean program listing, an error message will be printed and the printing may stop, depending on the type of error. Table 4-7 is the Boolean listing error messages and their definitions.

Table 4-7. Boolean Listing Error Messages and Definitions

ERROR MESSAGE		
INSTRUCTION	**OPERAND**	DEFINITION
ERROR	???	Not a valid instruction Incorrect operand

Cross Reference Printout

When the ladder diagram or Boolean printout of the user program has been **completed, the** printer will formfeed, then begin to print a cross reference printout of all outputs. The heading of this printout is, **OUTPUTS USED TABLE. The outputs referenced** in the user program (real world outputs, internal relays, shift registers and timers/counters) will have an annotation mark to the right of the reference number.

The outputs used table will continue printing until all output references have been printed. This printout cannot be stopped, as can the ladder diagram and Boolean listing printouts.

Expanded Print Format

When a more complex ladder diagram, using MCS and MCR functions, is to be printed out, an expanded print format is used. The starting point of each MCS function is denoted by a letter, the first is A, then B, etc. The letter is carried through to the end of each page and the beginning of the next page, providing a ready reference to the continuation of the ladder logic within the bounds of each MCS/MCR control. As multiple MCS functions and the logic under their control are printed, each succeeding group of logic is shifted to the right. When a group of logic under MCS/MCR control is ended by an MCR function, (MCR) is printed in the last column to the right and the letter corresponding to that MCS/MCR logic to its right.

Printout Annotation Explanation

Several items appearing on the printouts in figures 4-6 and 4-7 are explained for clarification. The ladder diagram printout in figure 4-6 has a circled number (l-5) next to each annotation, which corresponds to the number preceding the explanation of each annotation. The circled number 6 appears before an annotation on the Boolean printout in figure 4-7. The circled numbers (1-6) are for discussion purposes only and do not normally appear on a printout.

1. The type of printout on each page appears on this line, either LADDER DIAGRAM PRINTOUT, BOOLEAN PRINTOUT, or CROSS REFERENCE PRINTOUT.
2. This annotation, **V X.X, is the** version of the system operating software contained in PROM memory in the Printer Interface Unit.
3. The model of PC selected by the user as the program listing source will be on this line. The annotation will be either SERIES ONE JR/SR-10 for a Series One Junior PC or Series One, One Plus/SR-20, SR-21 for a Series One or Series One Plus PC.
4. 'The page number of the ladder diagram printout or Boolean printout will appear here as a 4-digit decimal number, starting with PAGE 0001.
5. Refers to ladder diagram printout only. This 4-digit decimal number is the user program memory address at the start of each rung of logic. The first element in the rung is stored at that address. In the example in figure 4-6, the memory address of the start of the first rung is 0000. The first element in that rung is a normally open contact referenced as 001 (reference number is printed directly above the contact). The memory address at the start of the second rung is 0013, the first element in this rung is a normally open contact referenced as 040.
6. Refers to Boolean printout only (figure 4-7). The # sign immediately following a numerical value in the Boolean printout listing, **indicates that the** value is a reference assigned to an element at the end of a rung.
7. A symbol preceding a numerical value in a Boolean printout, indicates that the value is a constant.

Sample Printout

A sample of each of the previously described printouts is shown in the following group of figures. For this group of printouts, a program was entered into a Series One Plus PC.

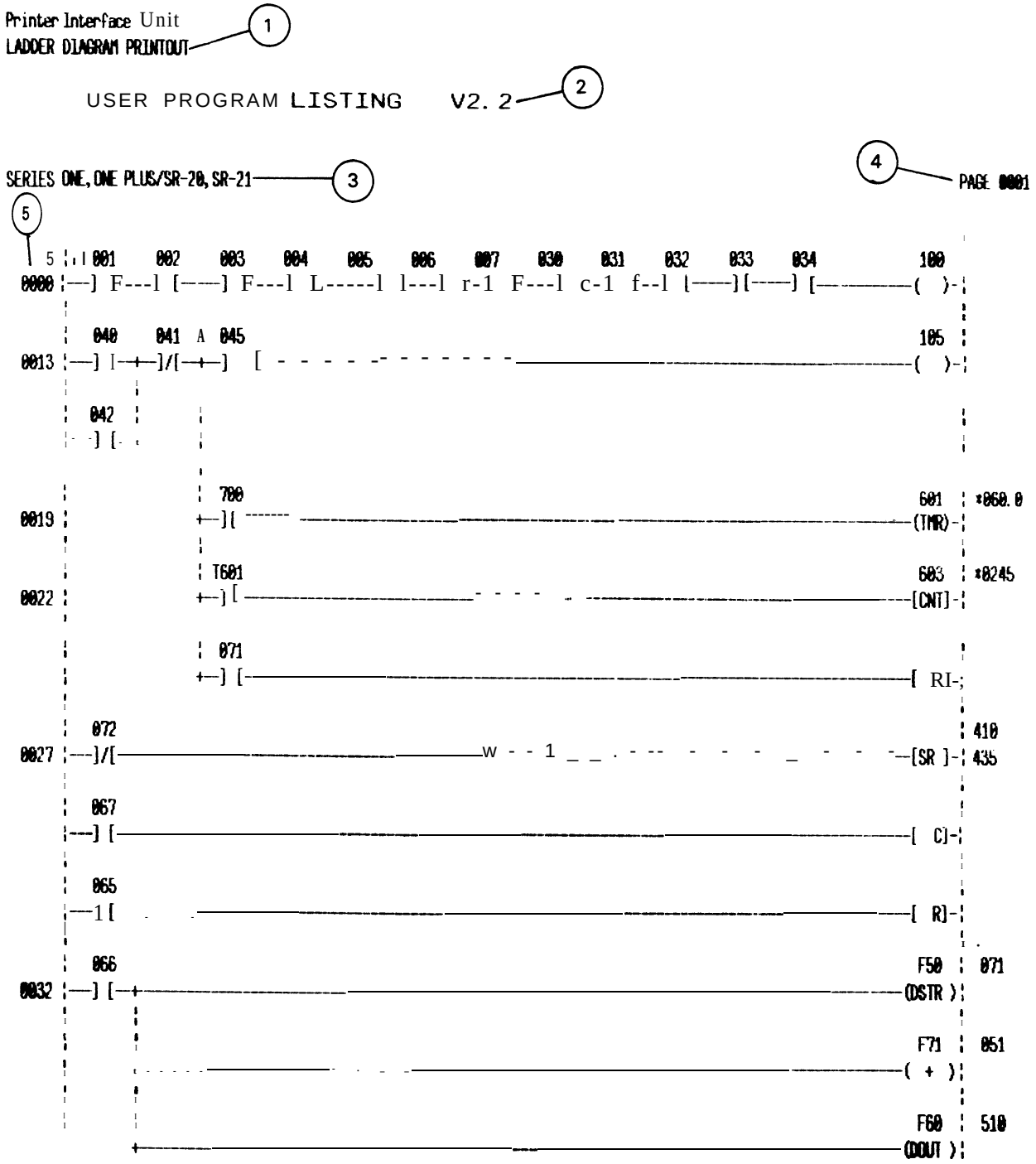


Figure 4-6. Sample Ladder Diagram Printout

Printer Interface hit
BOOLEAN PRINTOUT

USER PROGRAM LISTING V2.2

SERIES ONE, ONE PLUS/SR-20, SR-21 PAGE 0001

```
0000: STR      001      0050: -      0100: -      0150: -
0001: AND      002      0051: -      0101: -      0151: -
0002: AND      003      0052: -      0102: -      0152: -
0003: AND      004      0053: -      0103: -      0153: -
0004: AND      005      0054: -      0104: -      0154: -
0005: AND      006      0055: -      0105: -      0155: -
0006: AND      007      0056: -      0106: -      0156: -
0007: AND      030      0057: -      0107: -      0157: -
0008: AND      031      0058: -      0108: -      0158: -
0009: AND      032      0059: -      0109: -      0159: -
0010: AND      033      0060: -      0110: -      0160: -
0011: AND      034      0061: -      0111: -      0161: -
0012: OUT      100#     0062: -      0112: --     0162: -
0013: SIR      040      0063: -      0113: -      0163: -
0014: OR       042      0064: -      0114: -      0164: -
0015:  AND NOT 041      0065: -      em: -        0165: -
0016: MCS                0066: -      0116: -      0166: -
0017: STR      045  (6)  0067: -      0117: -      0167: -
0018: OUT  (7) 105#     0068: -      0118: -      0168: -
0019: STR      700      0069: -      0119: -      0169: -
0020: TMR   ,  601#     0070: -      0120: -      0170: -
0021:          #060. 0  0071: -      8121: -      0171: -
0022: SIR TMR  601      0072: -      0122: -      0172: -
0023: STR      071      0073: -      0123: -      0173: -
0024: CNT      603#     0074: -      0124: -      0174: -
0025:          # 0245   0075: -      0125: -      0175: -
0026: MCR                0076: -      0126: -      0176: -
0027: STR NOT  $72       0077: -      0127: -      0177: -
0028: STR      057      0078: -      0128: -      0178: -
0029: STR      055      0079: -      0129: -      0179: -
0030: SR       410#     0080: -      0130: -      0180: -
0031:          435#     0081: -      0131: -      0181: -
0032: STR      056      0082: -      0132: -      0182: -
0033: DSTR     (F50)    0083: -      0133: -      0183: -
0034:          071      0084: -      0134: -      0184: -
0035:  +       (071)    0085: -      0135: -      0185: -
0036:          051      0086: -      0136: -      0186: -
0037: DOUT     (F60)    0087: -      0137: -      0187: -
0038:          510#     0088: -      0138: -      0188: -
0039: -                 0089: -      0139: -      0189: -
0040: -                 0090: -      0140: -      0190: -
0041: -                 0091: -      0141: -      0191: -
0042: -                 0092: -      0142: -      0192: -
0043: -                 0093: -      0143: -      0193: -
0044: -                 0094: -      0144: -      0194: -
0045: -                 0095: -      0145: -      0195: -
0046: -                 0096: -      0146: -      0196: -
0047: -                 0097: -      0147: -      0197: -
0048: -                 0098: -      0148: -      0198: -
0049: -                 0099: -      0149: -      0199: -
```

Figure 4-7. Sample Boolean Printout

PROM Writer Unit

The PROM Writer unit (catalog number IC610PER154, version B replaces version A and can be used with Series One Plus as well as Series One and Series One Junior) is a compact, easy to use device that connects directly to and mounts on a Series One or Series One Plus PC. When mounted on a PC , the PROM Writer unit is used to write the contents of user memory to a 2732A-2 PROM (Series One), or a 27256-25 for a Series One Plus, thereby providing a non-volatile means of user program storage. After being written to, the appropriate PROM can be installed in any Series One or Series One Plus PC as required. Programs stored in PROM memory will not be lost during no-power conditions.

An additional feature of PROM memory is that different programs can be stored on individual PROMS for use as required by various applications. Another function of the PROM Writer unit is to transfer the user memory contained in a PROM to the CMOS memory in a Series One or Series One Plus.

On a Series One or Series One Plus PC, the PROM Writer unit physically mounts on the right of the front panel, in the same manner as the programmer. A connector on the lower left rear of the PROM Writer unit attaches to the connector on the front panel of the Series One or Series One Plus PC. The source of power for the PROM Writer unit is switch selectable and can be from the internal supply of the PC or from an external source of 5 V dc. Figure 4-10 is an illustration of the PROM Writer showing the location of its features, which are described in the text following the illustration.

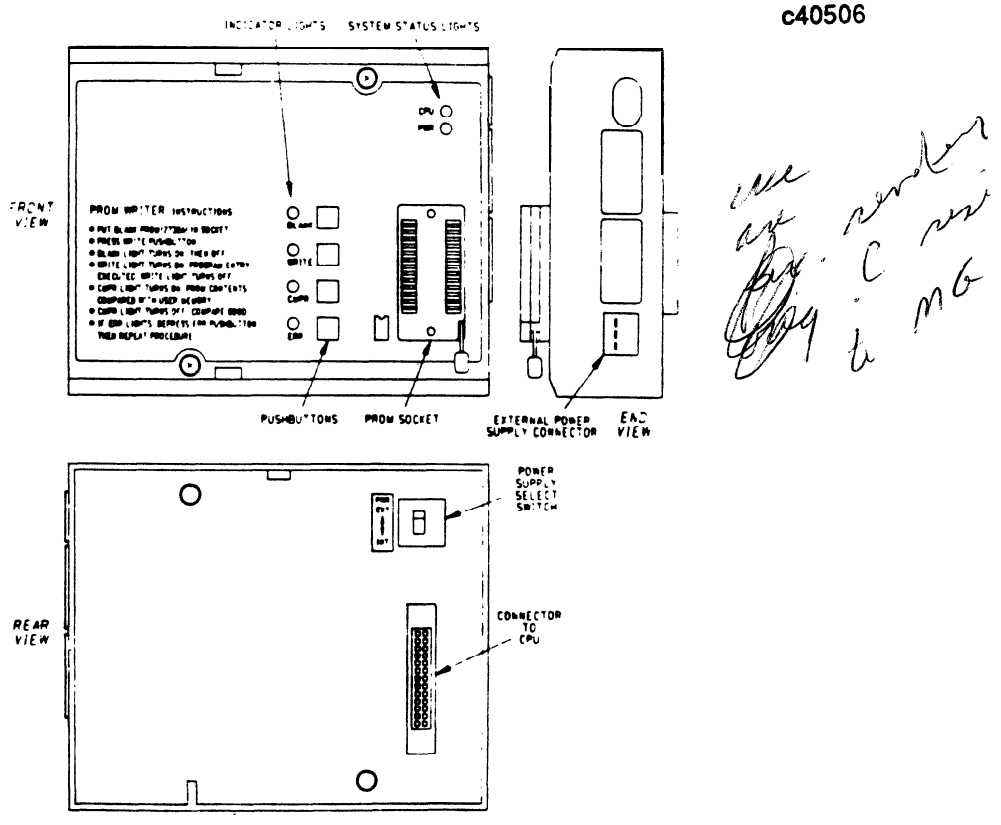


Figure 4-10. PROM Writer Unit Features

Front Panel Features

The front panel has two LEDs in the upper right comer which are visual indicators of system status. The purpose of the each indicator is described below.

PWR	The green PWR LED monitors the status of dc power being supplied to the PROM Writer unit.
ON	If power is being supplied by the CPU rack, this indicates that +5 V dc is being produced by the supply. If the PROM Writer unit is being powered from an external source, the +5 V dc being supplied is within the specified tolerance.
OFF	5 V dc not being supplied or not in tolerance.
CPU	The red CPU LED monitors the operating status of the CPU module. Identical to the CPU LED on the Series One or Series One Plus CPU module.
ON	CPU failure has been detected.
OFF	CPU operation is normal.

The socket on the lower right of the panel is used to contain the PROM being written to. The socket is a zero insertion force socket. To insert a PROM into the socket, push the locking handle up, insert the PROM, then lock the PROM in place by moving the handle down to the horizontal position. The PROM should be placed in the socket with the notch towards the end of the socket closest to the PWR LED as indicated by the figure on the panel next to the socket. Even though the spacing of the slots in the socket allows easy insertion of a PROM, care should be taken to ensure that leads on the PROM are not damaged.

Immediately to the left of the socket are 4 pushbuttons and their associated LED indicators. These pushbuttons are used to initiate operation of the PROM Writer unit and the LEDs are indicators for each part of the operation.

BLANK	When depressed, initiates checking of the PROM inserted in the socket for verification that the PROM does not have any information written into it. To initiate a blank check, the pushbutton is depressed. The light will turn on, then off, indicating a successful blank check. If the light remains on, and the ERR light turns on, the PROM needs to be erased. The BLANK light will also turn on, then off during the normal operation of writing to a PROM as indicated by the instructions printed on the lower left of the unit.
WRITE	When depressed, the WRITE pushbutton initiates the sequence of events that causes the user program in the Series One or Series One Plus CMOS memory to be written to the PROM. When the WRITE pushbutton is depressed, the BLANK light will turn on, then off. Next, the WRITE light turns on, program entry is executed, then the WRITE light turns off. A blank check and verify are performed automatically when the WRITE pushbutton is depressed.
CMPR	During the sequence for writing to a PROM, this light will turn on while the contents of the PROM are being compared to the contents of user memory in RAM. The CMPR light turns off when the compare is completed and is good. If the compare is not good, the CMPR light will remain on and the ERR light will turn on. In addition, the contents of a PROM inserted in tbe PROM Writer unit socket can be compared to the contents of user memory, whenever the CMPR pushbutton is depressed.
ERR	This light is a visual indication that the PROM writing operation has not been successful. If tbe light turns on during any portion of the operation, an error has occurred. If this does happen, depress the ERR pushbutton and repeat the procedure.

As a convenience to the user, the PROM Writer unit instructions for writing the contents of user memory to a PROM are printed on the lower left of the unit.

Sequence of Operation

The sequence of operation for writing the contents of user RAM memory to PROM memory is as follows:

WRITE OPERATION SEQUENCE	INDICATION
Depress WRITE pushbutton	WRITE light turn on
Blank check performed	WRITE light turns off BLANK light tums on
Write to PROM	BLANK light tums off WRITE light turns on
Verify contents of PROM with contents of RAM memory	WRITE light tums off CMPR light turns on
Write sequence successful	CMPR light tums Off

The sequence of operation for transferring the contents of PROM memory to CMOS memory is as follows (the CMOS memory should be cleared first):

PROM TO RAM OPERATION SEQUENCE	INDICATION
Depress WRITE and CMPR pushbutton at the same time. Contents of PROM will be transferred to RAM memory in the PC.	WRITE light and CMPR light will turn on.
Contents of PROM and RAM memory are compared.	WRITE light turns off.
Compare good. Sequence of operation complete.	CMPR light turns off *

*If an error is detected during the compare operation, the CMPR light will remain on and the ERR light will turn on.. The error can be cleared by depressing the ERR pushbutton. When this is done, the ERR and CMPR rights will tum off. If an error is indicated, repeat the operation.

External Power Supply Connector

A connector located on the right side of the PROM Writer unit provides the connections to an external power supply. A mating 3-pin connector with attached wires 3 feet (lm) in length, is provided with the PROM Writer unit for connection to the external supply. The color code for the external power supply cable and specifications for the power supply are as follows:

White	+5 V dc, ± 5% (rated at 0.5 amps)
Black	Power supply logic ground
Green	common system ground

Power Supply Select Switch

This is a two-position switch located on the bottom of the PROM Writer unit, directly above the 26-pin connector. The switch is used for selection of either internal or external dc power for the PROM Writer unit. The top switch position is labeled EXT (External) and the bottom position is labeled INT (Internal). When used with a Series One or Series One Plus PC mounted in a high-capacity rack, power can be supplied internally and the Power Supply Select Switch is set to INT.

If erratic operation is observed when attempting a data transfer using the PROM Writer, it is recommended that an external source of 5 V dc be used.

Timer/Counter Setpoint Unit

The Timer/Counter Setpoint Unit (IC609TCU100) provides an alternative method for entering a timer or counter preset value in a Series One Plus program. This unit can also be used with a Series One Junior. A Timer/Counter Setpoint Unit mounts on the Series One Plus rack that contains the CPU and plugs into the same connector as does the hand-held programmer. The Timer/Counter Setpoint Unit can also be connected remotely by using the 5 foot (1 .5m) remote programmer cable, IC610CBL102. With the unit mounted on the PC, the hand-held programmer can then be mounted on top of the Timer/Counter Setpoint Unit, thereby providing a convenient way to monitor the operation of timers or counters. The physical size of the unit is the same as the Data Communications Unit, Printer Interface Unit and the PROM Writer Unit.

a41 673

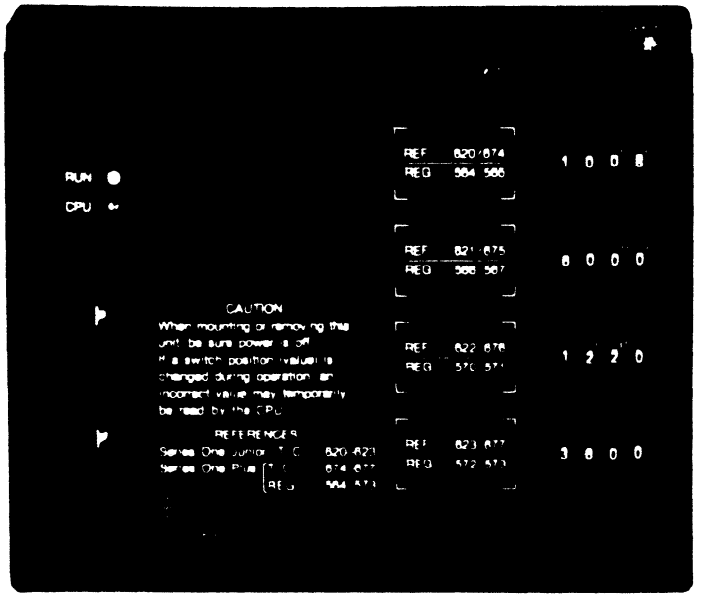


Figure 4-11. Timer/Counter Setpoint Unit

There are four 4-digit thumbwheel switches on the unit, which provides a convenient way to enter a 4-digit BCD value into each of 4 specific internal locations in the Series One Plus PC for use as Timer/Counter preset values. These values are simultaneously entered into data registers (two 8-bit registers for each BCD digit) for use as preset values or for other data operations. When the BCD preset values have been entered into the PC, they are retained in the PCs memory as presets, even though power is removed from the PC and the unit is removed.

Timer/Counter Setpoint Unit Specifications

The following table contains general specifications for the Timer/Counter Setpoint Unit.

Table 4-8. Timer/Counter Setpoint Specifications

Number of Circuits	4 (4 BCD digits per circuit)
Timer/Counter References	674, 675, 676, 677
Register References	564, 565 (T/C 674), 566, 567 (T/C 675) 570, 571 (T/C 676), 572, 573 (T/C 677)
Preset values	Timer: 0.1 to 999.9 seconds .01 to 99.99 seconds (Series One Plus 3.7 only) Counter: 1 to 9999 events
Ambient Temperature	0° to 50° (32" to 122°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity (non-condensing)	5% to 95%
Internal Power Consumption	5 V dc, 40 mA (maximum) 9 V dc, 5 mA (maximum)
Units of Load	4 units @ 5 V dc 1 unit @ 9 V dc
Environment Considerations	No corrosive gases

Remote Mounting of Timer/Counter Setpoint Unit

A Unit Mounting Bracket, IC610ACC190, is available which allows mounting of the Timer/Counter Setpoint Unit on the outside of a panel or console. The Unit Mounting Bracket consists of a mounting bracket, connector clamp and a cable clamp. The Timer/Counter Setpoint Unit mounts on the bracket, secured by two captive screws on the unit. The unit connects to a Series One Plus PC through the round 5 foot (1 .5m) remote programmer cable, IC610CBL102.

References for the Timer/Counter Setpoint Unit

The Timer/Counter references for the memory locations into which the BCD values are entered in the Series One Plus are 674, 675, 676 and 677. Each of the references refer directly to a memory location in the CPU that accepts one 4-digit BCD value as it is entered with each 4-position thumbwheel switch. Each thumbwheel position represents one BCD digit, with the least significant digit being the position to the right.

Each of the register references refers to an 8-bit data register. Two consecutive registers are required for each 4-digit BCD number.

Since all four BCD values are read into the PC each scan, discretion must be exercised when changing any values when the PC is running, since undesired intermediate values could be read by the CPU and used during one or several scans. It is recommended that the following CAUTION be followed.

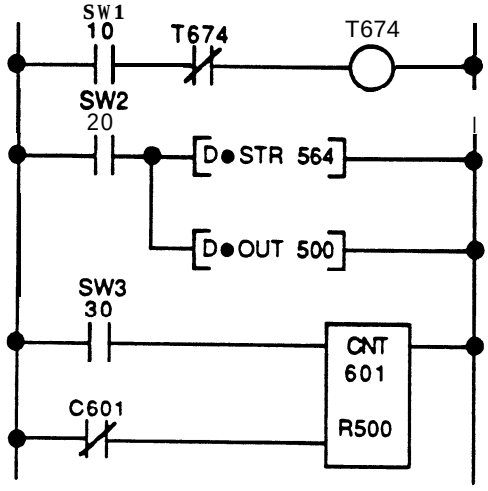
CAUTION

When mounting or removing the Timer/Counter Setpoint Unit, be sure that power is turned off. If a switch position (value) is changed during operation, an incorrect value may temporarily be read into the CPU.

Example of Using Thumbwheel Inputs

The following example of a ladder **diagram rung** shows how the Timer/Counter **Setpoint** Unit is used to enter a preset value into a Timer or counter, or to enter data into data **registers.**

a421 86



STR 10
AND NOT TMR 674
TMR 674

STR 20
F50
R564
F60
R500

STR 30
STR NOT CNT 601
CNT 601
R500

TIMER 674 USES THUMBWHEEL DATA FOR ITS PRESET VALUE.

WHEN SWITCH 2 IS CLOSED, THE THUMBWHEEL IS READ IN AND STORED IN A SAVE REGISTER, WHICH IS R500 IN THIS EXAMPLE.

THE VALUE IN THE SAVE REGISTER (500) IS USED AS THE PRESET VALUE FOR COUNTER 601.